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NEW AGE DATA ON THE GEOLOGICAL EVOLUTION OF SOUTHERN INDIA. P-3

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Extended Abstract

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The Peninsular Gneisses of Southern India developed over a period of several hundred Ma in the middle-to-late Archaean. Gneisses in the Gorur-Hassan area of southern Karnataka are the oldest recognized constituents: Beckinsale et al. (1) reported a preliminary Rb-Sr whole-rock isochron age of 3358 +/- 66 Ma, but further Rb-Sr and Pb/Pb whole-rock isochron determinations indicate a slightly younger, though more precise age of ca 3305 Ma (R.D.Beckinsale, pers. comm.). Many other Rb-Sr whole-rock isochron results for Peninsular Gneiss suites are within 100 Ma of 3000 Ma - summarised in (2). Some of these have initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios significantly higher than contemporaneous upper mantle sources, implying origins by some reworking of older crustal material in a major tectonothermal event at ca 3000 Ma.

It is well established that the Peninsular Gneisses constitute basement on which the Dharwar schist belts were deposited (3,4). Well-documented exposures of unconformities, with basal quartz pebble conglomerates of the Dharwar Supergroup overlying Peninsular Gneisses, have been reported from the Chikmagalur and Chitradurga areas (3,4), and basement gneisses in these two areas have been dated by Rb-Sr and Pb/Pb whole-rock isochron methods at ca 3150 Ma and ca 3000 Ma respectively (2). Dharwar supracrustal rocks of the Chitradurga schist belt are intruded by the Chitradurga Granite, dated by a Pb/Pb whole-rock isochron at 2605 +/- 18 Ma (2). These results indicate that the Dharwar Supergroup in the Chitradurga belt was deposited between 3000 Ma and 2600 Ma. A Pb/Pb whole-rock isochron date of 2565 +/- 28 Ma for Dharwar acid volcanic rocks north of the Honnali gneiss dome (2) might suggest diachronous development of the schist belts, but could reflect post-depositional disturbances, since the isochron is poorly fitted.

New Sm-Nd model age data [T-DM ages according to DePaolo's (5) model] for Peninsular Gneisses, Dharwar acid volcanic rocks, Chitradurga Granite and Sargur kyanite schists are consistent with existing chronological constraints for the evolution of the Karnataka Craton. T-DM model ages for Chikmagalur Granite [3.25 Ga], Chikmagalur gneiss [3.30 Ga], and Chitradurga gneiss

[3.15 Ga] are ca 100 - 150 Ma older than the Pb/Pb whole-rock isochron ages for the corresponding rock-units, probably reflecting the time interval between separation of crust-building material from upper mantle sources and the formation of the respective rock-units. However, the difference between T-DM model ages for the Chitradurga Granite [2.96 Ga] and the Dharwar acid volcanic rocks [2.99 & 3.06 Ga], and their corresponding Pb/Pb isochron ages [ca. 2.6 Ga.] is greater, ca 400 Ma, and indicates a significant contribution from reworked older continental crust in the petrogenesis of these younger acid igneous rock-units.

The basement to the Dharwar Supergroup, in addition to Peninsular Gneisses, consists of a suite of highly metamorphosed rocks of sedimentary and volcanic origin, designated the Sargur Group or supracrustal association, which occurs as inclusions within the Peninsular Gneisses.

Two kyanite schist samples of the Sargur supracrustal suite at Kodineer Katte give T-DM model ages of 3.09 Ga and 3.18 Ga. These results are closely comparable to a model age of 3.15 Ga for a Chitradurga gneiss sampled approx. 35 km to the SE. Sm-Nd model ages for pelitic sediments and metasediments have received much attention in recent years (e.g. 6), and the usual pattern is that for Archaean samples the Sm-Nd model age is generally very close to the depositional age, whereas in younger samples the model age usually exceeds the depositional age substantially (6). Sm-Nd model ages for pelites are generally regarded as providing a good estimate of the average crustal residence age of the sediment; in the Archaean it is inferred that most pelites represent first cycle sediments, derived from newly formed crust. The significance of the Sargur kyanite schist model ages is that they are substantially younger than the oldest known constituents of the Peninsular Gneiss Complex, and indeed demonstrate that these pelitic rocks can only have been deposited a short time prior to the emplacement of the precursors of the gneisses within which they are now found as inclusions. It has been considered that the Sargur supracrustal rocks might represent the earliest components of the Karnataka craton, but these results demonstrate that the deposition of at least some of the rocks assigned to the Sargur supracrustals post-dates early phases of the Peninsular Gneiss Complex. It remains to be seen whether there is any diachroneity in the development of the Sargur supracrustal association. Sm-Nd work is currently in progress on other Karnataka samples, including more Sargur rocks.

In addition to our study of the Chitradurga and Chikmagalur areas, we have carried out Pb isotopic analyses of samples of the Closepet Granite towards the southern end of its outcrop, and of the Peninsular Gneisses on either side of the granite.

The Closepet Granite is an elongate, arcuate body extending northwards from near the Tamil Nadu / Karnataka border, passing to the west of Bangalore, through Tumkur, and continuing beyond Bellary on a north-north-easterly trend. The southern end of the granite is in the transition zone between the charnockite terrane of Tamil Nadu and the amphibolite facies Peninsular

Gneisses of Karnataka. Friend (7) considers that formation of the Closepet Granite and development of the charnockites were almost synchronous events, based on observation of granite veins cross-cutting charnockitized Peninsular Gneisses, and of charnockite development overprinting some of the granite veins, relationships clearly exposed in the quarries at Kabbaldurga.

For this study, we have analysed suites of grey gneisses from Dasapandoddi and Agasanapura, respectively east and west of the Closepet granite outcrop, and suites of Closepet Granite samples from quarries at Ramnagaram (formerly Closepet), and from a traverse across the granite outcrop along the Tumkur - Bangalore road. Pb/Pb isochron results for these suites are as follows:-

Dasapandoddi Grey Gneisses [7]	2529 +/- 32 Ma.	Model $\mu 1$	8.19
Agasanapura Grey Gneisses [7]	2535 +/-152 Ma.	Model $\mu 1$	7.65
Closepet Granite [8]	2578 +/-156 Ma.	Model $\mu 1$	7.95

Clearly the age results are very similar, although the Dasapandoddi isochron is a much more precise determination than the others. Together they suggest that a major tectonothermal event took place at ca 2500 Ma, but the substantial variations in model $\mu 1$ values (source 238-U/204-Pb ratios) indicate that the rock-units evolved from sources or precursor materials with significantly different U-Pb fractionation histories. On their own, the model $\mu 1$ values do not provide unequivocal evidence for the involvement of older continental crust in the petrogenesis of these rock-units, so that the assessment of the role and character of any older crust in the ca 2500 Ma event in south-east Karnataka will require additional data. Sm-Nd analyses on these suites and on samples of gneisses, granites and charnockites from the Kabbaldurga quarries are in progress.

Roy Goodwin may not be able to squeeze blood out of a stone, but if you want Pb from a rock, then he's the leading man. John Arden exacted Sm and Nd from the rock samples with menaces and HF. Our thanks to them both.

References.

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